Ethernet to SpaceWire Bridge – An Evolution of Services

Marko Isomäki, Kristoffer Glembo, Sandi Habinc

Aeroflex Gaisler AB
Kungsgatan 12, SE-411 19 Göteborg, Sweden

marko@gaisler.com

www.Aeroflex.com/Gaisler

Introduction

The Aeroflex Gaisler Ethernet to SpaceWire bridge (GRESB) provides bridging between three SpaceWire links and one Ethernet link.

The intended application is generation of testdata on a host computer which is sent to any of the SpaceWire links over Ethernet.

This facilitates rapid development and testing of SpaceWire equipment.

This device has been available since 2006 with 100 Mbit/s SpaceWire links and 10/100 Mbit/s Ethernet. The number of applications requiring even higher speed has increased from year to year making it necessary to upgrade the bridge.

Increase in customers wanting bridges to other interfaces such as CAN 2.0B, MIL-STD-1553B

This presentation will focus both on the technical details of the current device and the planned evolution to a more performant and version with support for more interfaces..

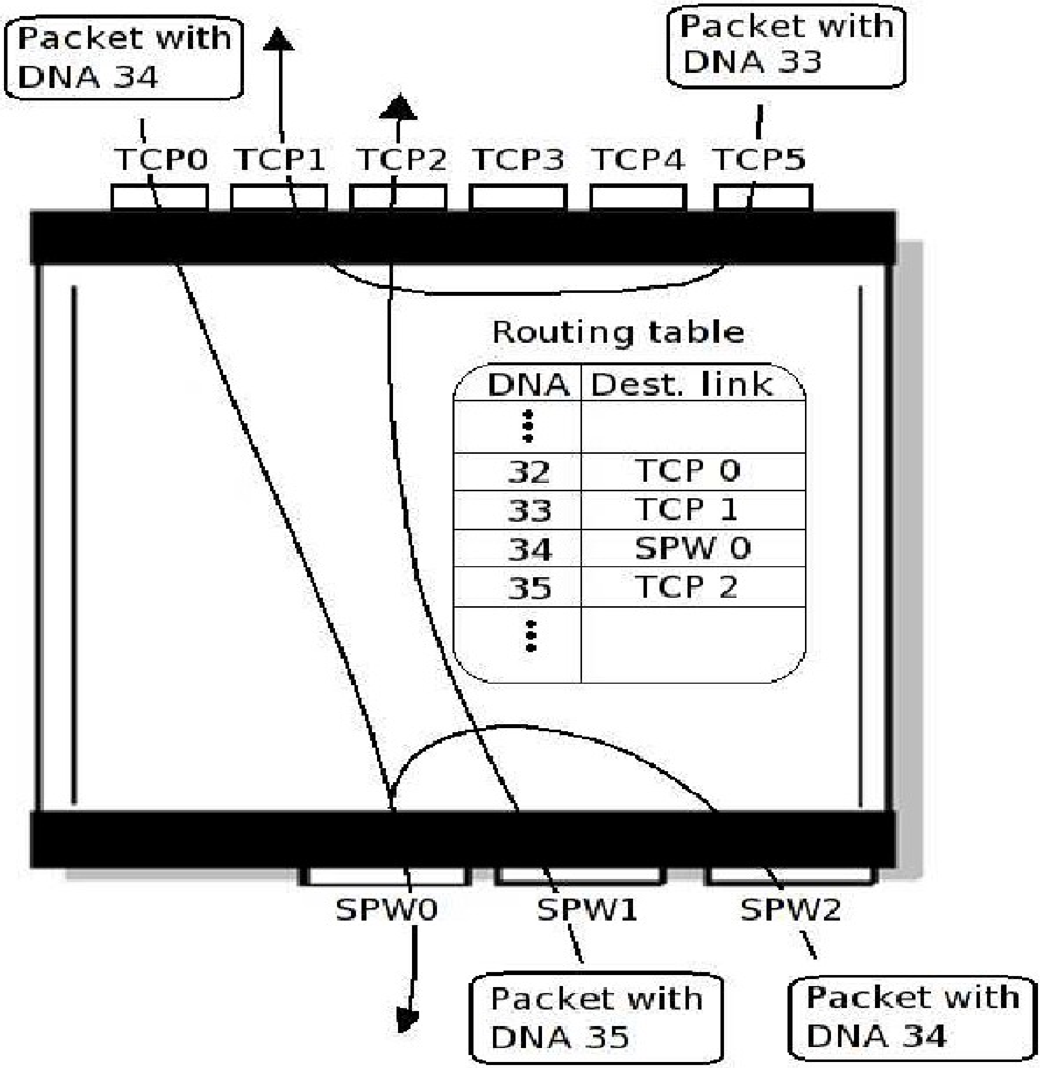
Current device specification

- Three SpaceWire links at 100 Mbit/s.
- One Ethernet link at 10/100 Mbit/s.
- 6 Virtual links interfaced over Ethernet using TCP/IP.
- Routing done in software using a uCLinux (linux-2.0.x) kernel.
- Each link physical or virtual is assigned one or more single byte SpaceWire addresses.
- Configuration and status available through webinterface.
- Hardware based on a Xilinx Spartan3 FPGA board running at 50 MHz with a Leon3 processor and the Aeroflex Gaisler GRSPW and GRETH SpaceWire and Ethernet cores.

Operation

- We want to send and receive SpaceWire data from/to a host computer.
- The bridge is connected to the host using Ethernet.
- The communication is done using a simple protocol in the TCP/IP data payload.
- The protocol is open so it can be used in custom applications.
- The bridge comes with a software package supporting the most common operations such as send, receive, configuration and status.
- The bridge's routing table has a default setup which means data transfers can be done immediately if the default route is sufficient.

Example of traffic through the bridge



SpaceWire IP tunneling

IP tunneling allows for easy connection between SpaceWire equipment at two remote sites.

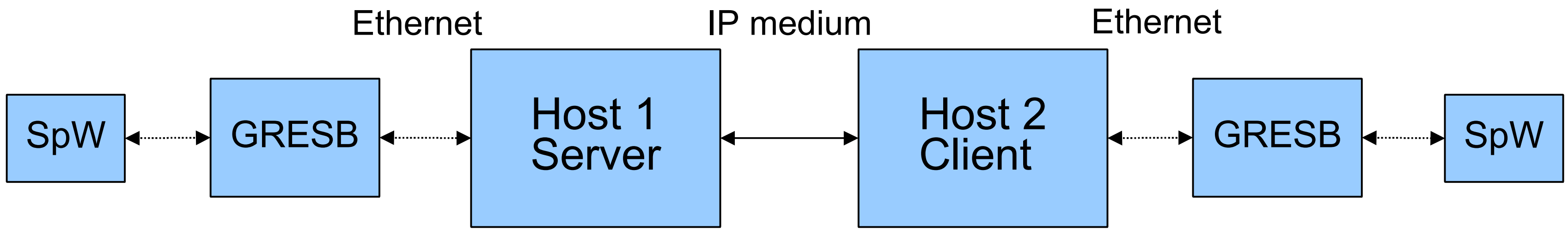
Two hosts connect to their respective GRESB units using the provided tunneling software.

One is selected as a server and the other as the client.

The client connects to the server and then traffic can automatically flow between SpaceWire units on the two remote networks.

The routes of course have to be correctly setup at both ends for this to work.

Note that it is not necessary to have the server or client running on different hosts.



Remote debugging

The bridge supports remote debugging of SpaceWire systems using Aeroflex Gaisler's GRMON debug monitor.

GRMON is run on a host computer and communicates with the LEON3 debug support unit and allows non-intrusive debugging of the complete target system.

Normally it interfaces to the target system directly through for example Ethernet or USB.

Target boards with only SpaceWire would normally not be accessible since host computers do not have SpaceWire interfaces.

The bridge provides this support by having the Ethernet link inbetween.

The user only needs to specify the bridge's ip address, which SpaceWire lin to access, SpW destination address and the SpW source address.

Throughput

SpaceWire cores run at 100 Mbit/s resulting in maximum throughput of 3*100*0.76*2=456 Mbit/s full duplex.

The Ethernet link operates at a maximum of 100 Mbit/s and with protocol overhead (in the frames) taken into account it can handle ~180 Mbit/s full-duplex.

Due to the TCP/IP socket being run in software the limiting factor will be the CPU which in the current configuration limits Ethernet throughput to 50 Mbit/s full-duplex.

The ideal Ethernet throughput is not close to the maximum SpaceWire throughput and the processor limits it even more.

Next generation bridge v 2.0

The FPGA board will be changed to a Xilinx Spartan6 allowing for a ~30% increase in processor performance.

SpaceWire cores will be changed to a GRSPWROUTER with 200 Mbit/s links. All SpaceWire routing will now be done in hardware.

SpaceWire to SpaceWire routing will not consume any bus bandwidth.

Ethernet core will be changed to GRETH_GBIT supporting 1000 Mbit/s with ~900 Mbit/s ideal throughput.

TCP/IP socket links will be the same as in v 1.0 with the same limitations.

In addition to this an UDP based transfer protocol implemented in hardware will provide a high speed Ethernet channel with 500 Mbit/s effective throughput.

New interfaces

A lot of customers have expressed the need for the same type of bridging as currently available but to other interfaces such as CAN 2.0B, MIL-STD-1553B, CCSDS/ECSS TM/TC and SPI.

New TCP/IP sockets will be assigned to the respective interface meaning that the routing table will not be changed.

It is still not specified whether there will be direct routing on the bridge between the different interfaces or only to/from TCP/IP sockets.

It is also possible that after the migration to the GRSPWROUTER the number of SpaceWire ports can be increased to up to eight.

In total the new interfaces will require a new box to fit all the connectors.

Any feedback on which interfaces and functionality is useful is welcome.

Block diagram v 2.0